We Claim:

1. An apparatus for cooling, comprising:

a condenser having a heat transfer surface, wherein the condenser acts as a heat exchanger so that heat is removed from a compressed refrigerant by a first external fluid in thermal contact with the heat transfer surface of the condenser;

an expansion device, wherein the expansion device receives refrigerant from the condenser, wherein the refrigerant received from the condenser is expanded through the expansion device;

an evaporator, wherein the refrigerant exiting the expansion device flows through the evaporator, wherein the evaporator is in thermal contact with a heat source, wherein the refrigerant absorbs heat from the heat source as the refrigerant passes through the evaporator;

a compressor, wherein the compressor receives the refrigerant exiting from the evaporator, wherein the compressor compresses the refrigerant received from the evaporator, wherein the compressed refrigerant exits the compressor and flows into the condenser; and

a means for flowing the first external fluid across the heat transfer surface of the condenser, wherein the flow of the first external fluid is substantially parallel with the heat transfer surface of the condenser.

2. The apparatus for cooling according to claim 1,

wherein the heat source is a second external fluid, wherein the second external fluid flows through the evaporator such that the refrigerant and the second external fluid are in thermal contact, wherein the refrigerant absorbs heat from the second external fluid as the refrigerant passes through the evaporator.

3. The apparatus for cooling according to claim 2,

wherein the condenser acts as a heat exchanger so that heat is removed from compressed refrigerant vapor by the first external fluid in thermal contact with the heat

transfer surface of the condenser such that the temperature of the compressed refrigerant vapor decreases below the saturation temperature of the refrigerant and the refrigerant vapor condenses to liquid refrigerant,

wherein the liquid refrigerant exits the condenser and is expanded through the expansion device, wherein the pressure and temperature of the liquid refrigerant are reduced upon exiting the expansion device,

wherein the liquid refrigerant exiting the expansion device flows through the evaporator, wherein the second external fluid flows through the evaporator such that the liquid refrigerant and the second external fluid are in thermal contact, wherein the liquid refrigerant absorbs heat from the second external fluid as the liquid refrigerant passes through the evaporator such that the liquid refrigerant boils to produce vapor, wherein the vapor exits the evaporator, and

wherein the compressor receives the refrigerant vapor exiting from the evaporator, wherein the compressor compresses the refrigerant vapor to a pressure at which the vapor temperature is above the ambient temperature of the condenser, wherein the compressed refrigerant vapor exits the compressor and flows into the condenser, wherein heat is removed from the compressed refrigerant vapor by the first external fluid in thermal contact with the heat transfer surface of the condenser such that the temperature of the compressed refrigerant vapor decreases below the saturation temperature of the refrigerant and the refrigerant vapor condenses to liquid refrigerant.

4. The apparatus for cooling according to claim 1,

wherein the condenser comprises a second surface, wherein the second surface is substantially parallel to the heat transfer surface, wherein the condenser has a substantially tubular shape having a first end and a second end, wherein the heat transfer surface is on the exterior side of the substantially tubular shaped condenser and the second surface is on the interior side of the substantially tubular shaped condenser, and wherein a volume is formed by the second surface of the substantially tubular shaped condenser.

5. The apparatus for cooling according to claim 4,

wherein the flow of the first external fluid is substantially from the first end of the condenser to the second end of the condenser.

6. The apparatus for cooling according to claim 1,

wherein the compressed refrigerant from which heat is removed by the first external fluid in thermal contact with the heat transfer surface flows through the condenser such that the flow of the compressed refrigerant is substantially parallel to the heat transfer surface.

7. The apparatus for cooling according to claim 4,

wherein the condenser has a cross-sectional shape selected from a group consisting of: rectangular, polygonal, square, hexagonal, peanut, and oval.

8. The apparatus for cooling according to claim 4,

wherein the condenser has a substantially circular cross-sectional shape.

9. The apparatus for cooling according to claim 4,

wherein the compressor is positioned substantially within the volume formed by the second surface of the condenser.

10. The apparatus for cooling according to claim 9,

wherein the evaporator is positioned substantially within the hollow volume formed by the second surface of the condenser.

11. The apparatus for cooling according to claim 10,

wherein the expansion device is positioned substantially within the hollow volume formed by the second surface of the condenser.

12. The apparatus for cooling according to claim 9,

wherein the compressor is substantially cylindrical in shape.

13. The apparatus for cooling according to claim 12, further comprising:

a motor, wherein the motor is substantially cylindrical in shape, and wherein the motor drives the compressor.

14. The apparatus for cooling according to claim 13,

wherein the motor is positioned substantially within the hollow volume formed by the second surface of the condenser.

15. The apparatus for cooling according to claim 13, further comprising:

a means for pumping the second external fluid through the evaporator.

16. The apparatus for cooling according to claim 15,

wherein the motor drives the means for pumping the second external fluid through the evaporator, wherein the motor, the evaporator, and the means for pumping the second external fluid through the evaporator are positioned substantially within the hollow volume formed by the second surface of the condenser.

17. The apparatus for cooling according to claim 15,

wherein the evaporator is substantially cylindrical in shape, wherein the evaporator comprises a pair of parallel channels which spiral from the center of the evaporator to the outer portion of the evaporator, wherein the liquid refrigerant flows through one of the channels of the pairs of parallel channels and the second external fluid flows through the other channel of the pair of parallel channels such that liquid refrigerant and the second external fluid flowing in the pair of parallel channels are in thermal contact with each other.

18. The apparatus for cooling according to claim 17,

wherein each channel of the pair of parallel channels substantially follows the path of a corresponding archemidian spiral.

19. The apparatus for cooling according to claim 1,

wherein the condenser is a gas to vapor heat exchanger, where the vapor is hotter than the gas.

20. The apparatus for cooling according to claim 1,

wherein the condenser is a liquid to vapor heat exchanger, wherein the vapor is hotter than the liquid.

21. The apparatus for cooling according to claim 1,

wherein the expansion device is throttling valve.

22. The apparatus for cooling according to claim 1,

wherein the temperature of the liquid refrigerant liquid is reduced to at least to corresponding saturation temperature upon exiting the expansion device.

23. The apparatus for cooling according to claim 2,

wherein the second external fluid is a liquid.

24. The apparatus for cooling according to claim 2,

wherein the second external fluid is a gas.

25. The apparatus for cooling according to claim 1,

wherein the compressor comprises a positive displacement means such that a first volume of refrigerant vapor enters the positive displacement means and is compressed such that a second volume of compressed refrigerant vapor exits the positive displacement means, wherein the second volume is smaller than the first volume.

26. The apparatus for cooling according to claim 25,

wherein the positive displacement means comprises a mechanism selected from the group consisting of: a piston, a sliding vane, a screw, and a scroll.

27. The apparatus for cooling according to claim 25,

wherein the positive displacement comprises a rotary lobe,

wherein the rotary lobe comprises a substantially triangular shape rotor which spins on an eccentric shaft, wherein the rotor rotates inside an epiterchoid chamber.

28. The apparatus for cooling according to claim 27, further comprising:

one or more spring loaded tip seals on the rotor.

29. The apparatus for cooling according to claim 27, further comprising:

one or more spring loaded face seals on the rotor.

30. The apparatus for cooling according to claim 27, further comprising:

a means for driving the shaft which spins the rotor.

31. The apparatus for cooling according to claim 27, further comprising:

a motor, wherein the motor drives the shaft which spins the rotor.

32. The apparatus for cooling according to claim 31, further comprising:

a motor controller, wherein the motor controller controls the speed of the motor to adjust the rate of compression cycles..

33. The apparatus for cooling according to claim 32,

wherein the motor controller adjusts the rate of compression cycles to match the cooling load.

34. The apparatus for cooling according to claim 1,

wherein the first external fluid is air.

35. The apparatus for cooling according to claim 1,

wherein the first external fluid is water.

36. The apparatus for cooling according to claim 1,

wherein the compressor comprises an outside housing having a plurality of fins, wherein the plurality

37. The apparatus for cooling according to claim 1,

wherein the exterior surface of the condenser comprises an enhanced surface geometry,

wherein the enhanced surface geometry enhances heat removal by the first external fluid.

38. The apparatus for cooling according to claim 37,

wherein the first external fluid is ambient air, wherein the enhanced surface geometry of the exterior surface of the condenser comprises a plurality of extended surface features, wherein the plurality of extended surface features increase the surface area of the exterior surface of the condenser compared with a base surface area of the exterior surface of the condenser.

39. The apparatus for cooling according to claim 38,

wherein the plurality of extended surface features comprises a plurality of fins extending from the exterior surface of the condenser.

40. The apparatus for cooling according to claim 39,

wherein the cross-sectional shape of at least a portion of the plurality of fins is selected from the group of cross-sectional shapes consisting of: round, elliptical, square, and rectangular.

41. The apparatus for cooling according to claim 38,

wherein the extended surface features increase the surface area of the exterior surface of the condenser by at least a factor of 2 compared with the base surface area of the exterior surface of the condenser.

42. The apparatus for cooling according to claim 38,

wherein the base surface area of the exterior surface of the condenser is between about 200 square centimeters and about 500 square centimeters.

43. The apparatus for cooling according to claim 38,

wherein the extended surface features increase the surface area of the exterior surface of the condenser by a factor of between about 2 and about 5 compared with the base surface area of the exterior surface of the condenser.

44. The apparatus for cooling according to claim 43,

wherein the base surface area of the exterior surface of the condenser is between about 200 square centimeters and about 500 square centimeters.

45. The apparatus for cooling according to claim 44,

wherein the apparatus for cooling provides up to 300 watts of cooling.

46. The apparatus for cooling according to claim 38,

wherein the base surface area of the exterior surface of the condenser is between about 300 square centimeters and about 400 square centimeters, wherein the plurality of extended surface features increase the surface area of the exterior surface of the condenser by a factor of between about 2.5 and about 4, wherein the apparatus for cooling provides between about 200 and about 250 watts of cooling.

47. The apparatus for cooling according to claim 38,

wherein the plurality of extended surface features have a substantially elliptical cross-section, such that the direction of air flow across the plurality of extended surface features is along the major axes of extended surface features.

48. The apparatus for cooling according to claim 47,

wherein the plurality of extended surface features are positioned on the exterior surface of the condenser in a staggered arrangement with respect to the direction of air flowing across the surface of the heat transfer surface of the condenser.

49. The apparatus for cooling according to claim 48,

wherein the spacing between the major axis of adjacent extended surface features is about 2.5 times the equivalent diameter of the elliptical cross-sectional shape of the extended surface features and the minor axes to minor axes spacing between staggered rows of extended surface features is about 2.5 times the equivalent diameter of the elliptical cross-sectional shape of the extended surface features.

50. The apparatus for cooling according to claim 1,

wherein the first external fluid is ambient air, and wherein the means for flowing the first external fluid across the surface of the heat transfer surface of the condenser is a fan.

51. The apparatus for cooling according to claim 50,

wherein the fan flows a portion of the first external fluid through the hollow volume formed by the second surface of the condenser.

52. The apparatus for cooling according to claim 1, further comprising:

an outer layer, wherein the outer layer surrounds the heat transfer surface of the condenser so as to form a second volume between the heat transfer surface of the condenser and the outer layer,

wherein the first external fluid flowing across the exterior surface of the condenser flows through the second volume.

53. The apparatus for cooling according to claim 52,

wherein the first external fluid flowing across the heat transfer surface of the condenser flows from the first end of the condenser toward the second end of the condenser.

54. The apparatus for cooling according to claim 52, further comprising:

a means for flowing a portion of the first external fluid through the volume formed by the second surface of the condenser from the first end of the condenser to the second end of the condenser.

55. The apparatus for cooling according to claim 54,

wherein the second volume between the outer layer and the heat transfer surface of the condenser is at a lower temperature than the hollow volume formed by the second surface of the condenser.

56. The apparatus for cooling according to claim 1, further comprising:

tubing in thermal contact with the condenser, wherein the compressed refrigerant vapor flows through the tubing such that heat is transferred from the compressed refrigerant vapor to the condenser.

57. The apparatus for cooling according to claim 56,

wherein the tubing spirals around in thermal contact with the condenser from the first end of the condenser to the second end of the condenser.

58. The apparatus for cooling according to claim 1,

wherein the condenser comprises a first element and a second element, wherein the first element is inserted inside of the second element such that a duct is

formed between the first element and the second element for the flow of the compressed refrigerant vapor through the condenser, wherein an interior surface of the first element is the second surface of the condenser and an exterior surface of the second element in the heat transfer surface of the condenser.

59. The apparatus for cooling according to claim 58,

wherein the duct is a helical duct.

60. The apparatus for cooling according to claim 58,

wherein a plurality of ducts are formed between the first element and the second element such that the plurality of ducts are parallel with each other.

61. The apparatus for cooling according to claim 6,

wherein the flow of the compressed refrigerant is substantially perpendicular to the flow of the first external fluid

62. A condenser, comprising:

a heat transfer surface, wherein the condenser acts as a heat exchanger so that heat is removed from a compressed refrigerant by a first external fluid in thermal contact with the heat transfer surface of the condenser; and

a means for flowing the first external fluid across the heat transfer surface of the condenser, wherein the flow of the first external fluid is substantially parallel with the heat transfer surface of the condenser.

63. The condenser according to claim 62,

wherein the condenser acts as a heat exchanger so that heat is removed from compressed refrigerant vapor by the first external fluid in thermal contact with the heat transfer surface of the condenser such that the temperature of the compressed refrigerant vapor decreases below the saturation temperature of the refrigerant and the refrigerant vapor condenses to liquid refrigerant, wherein compressed refrigerant vapor flows into

the condenser, wherein heat is removed from the compressed refrigerant vapor by the first external fluid in thermal contact with the heat transfer surface of the condenser such that the temperature of the compressed refrigerant vapor decreases below the saturation temperature of the refrigerant and the refrigerant vapor condenses to liquid refrigerant.

64. The condenser according to claim 62,

wherein the condenser comprises a second surface, wherein the second surface is substantially parallel to the heat transfer surface, wherein the condenser has a substantially tubular shape having a first end and a second end, wherein the heat transfer surface is on the exterior side of the substantially tubular shaped condenser and the second surface is on the interior side of the substantially tubular shaped condenser, and wherein the volume is formed by the second surface of the substantially tubular shaped condenser.

65. The condenser according to claim 64,

wherein the flow of the first external fluid is substantially from the first end of the condenser to the second end of the condenser.

66. The condenser according to claim 62,

wherein the compressed refrigerant from which heat is removed by the first external fluid in thermal contact with the heat transfer surface flows through the condenser such that the flow of the compressed refrigerant is substantially parallel to the heat transfer surface.

67. The condenser according to claim 66,

wherein the flow of the compressed refrigerant is substantially perpendicular to the flow of the first external fluid.

68. The condenser according to claim 64,

wherein the condenser has a cross-sectional shape selected from a group consisting of: rectangular, polygonal, square, hexagonal, peanut, and oval.

69. The condenser according to claim 64,

wherein the condenser has a substantially circular cross-sectional shape.

70. The condenser according to claim 62,

wherein the condenser is a gas to vapor heat exchanger, where vapor is hotter than the gas.

71. The condenser according to claim 62,

wherein the condense is a liquid to vapor heat exchanger, wherein the vapor is hotter than the liquid.

72. The condenser according to claim 62,

wherein the first external fluid is air

73. The condenser according to claim 62,

wherein the first external fluid is water.

74. The condenser according to claim 62,

wherein the exterior surface of the condenser comprises an enhanced surface geometry,

wherein the enhanced surface geometry enhances heat removal by the first external fluid.

75. The condenser according to claim 74,

wherein the first external fluid is ambient air, wherein the enhanced surface geometry of the exterior surface of the condenser comprises a plurality of extended surface features, wherein the plurality of extended surface features increase the surface

area of the exterior surface of the condenser compared with a base surface area of the exterior surface of the condenser.

76. The condenser according to claim 75,

wherein the plurality of extended surface features comprises a plurality of fins extending from the exterior surface of the condenser.

77. The condenser according to claim 76,

wherein the cross-sectional shape of at least a portion of the plurality of fins is selected from the group of cross-sectional shapes consisting of: round, elliptical, square, and rectangular.

78. The condenser according to claim 75,

wherein the extended surface features increase the surface area of the exterior surface of the condenser by at least a factor of 2 compared with the base surface area of the exterior surface of the condenser.

79. The condenser according to claim 75,

wherein the base surface area of the exterior surface of the condenser is between about 200 square centimeters and about 500 square centimeters.

80. The condenser according to claim 75,

wherein the extended surface features increase the surface area of the exterior surface of the condenser by a factor of between about 2 and about 5 compared with the base surface area of the exterior surface of the condenser.

81. The condenser according to claim 80,

wherein the base surface area of the exterior surface of the condenser is between about 200 square centimeters and about 500 square centimeters.

82. The condenser according to claim 75,

wherein the base surface area of the exterior surface of the condenser is between about 300 square centimeters and about 400 square centimeters, wherein the plurality of extended surface features increase the surface area of the exterior surface of the condenser by a factor of between about 2.5 and about 4.

83. The condenser according to claim 75,

wherein the plurality of extended surface features have a substantially elliptical cross-section, such that the direction of air flow across the plurality of extended surface features is along the major axes of extended surface features.

84. The condenser according to claim 83,

wherein the plurality of extended surface features are positioned on the exterior surface of the condenser in a staggered arrangement with respect to the direction of air flowing across the surface of the heat transfer surface of the condenser.

85. The condenser according to claim 84,

wherein the spacing between the major axis of adjacent extended surface features is about 2.5 times the equivalent diameter of the elliptical cross-sectional shape of the extended surface features and the minor axes to minor axes spacing between staggered rows of extended surface features is about 2.5 times the equivalent diameter of the elliptical cross-sectional shape of the extended surface features.

86. The condenser according to claim 62,

wherein the first external fluid is ambient air, and wherein the means for flowing the first external fluid across the surface of the heat transfer surface of the condenser is a fan.

87. The condenser according to claim 86,

wherein the fan flows a portion of the first external fluid through the hollow volume formed by the second surface of the condenser.

88. The condenser according to claim 62, further comprising:

an outer layer, wherein the outer layer surrounds the heat transfer surface of the condenser so as to form a second volume between the heat transfer surface of the condenser and the outer layer,

wherein the first external fluid flowing across the exterior surface of the condenser flows through the second volume.

89. The condenser according to claim 88,

wherein the first external fluid flowing across the heat transfer surface of the condenser flows from the first end of the condenser toward the second end of the condenser.

90. The condenser according to claim 88, further comprising:

a means for flowing a portion of the first external fluid through the volume formed by the second surface of the condenser from the first end of the condenser to the second end of the condenser.

91. The condenser according to claim 62, further comprising:

tubing in thermal contact with the condenser, wherein the compressed refrigerant vapor flows through the tubing such that heat is transferred from the compressed refrigerant vapor to the condenser.

92. The condenser according to claim 91,

wherein the tubing spirals around in thermal contact with the condenser from the first end of the condenser to the second end of the condenser.

93. The condenser according to claim 62,

wherein the condenser comprises a first element and a second element, wherein the first element is inserted inside of the second element such that a duct is formed between the first element and the second element for the flow of the compressed refrigerant vapor through the condenser, wherein an interior surface of the first element is the second surface of the condenser and an exterior surface of the second element in the heat transfer surface of the condenser.

94. The condenser according to claim 93,

wherein the duct is a helical duct.

95. The condenser according to claim 93,

wherein a plurality of ducts are formed between the first element and the second element such that the plurality of ducts are parallel with each other.